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ABSTRACT

A study was undertaken to evaluate the effectiveness of a training program to help teachers instruct students in finding the relationship between questions designed to test their comprehension of a text and the location of possible information for answering those questions. Specifically, the study examined whether training would enhance student performance in three areas: (1) sensitivity to the task demands of the question, (2) quality of answers, and (3) consistency between their identification of the task demands of a question and the source of information needed for the answer. Subjects were 10 fourth grade teachers and 180 of their students from a semi-rural western community. Three of the teachers were trained in a traditional half-day workshop, three received more extensive training that included provision of specific materials and weekly monitoring and feedback by researchers, and four served as controls. The performance of high ability students was superior to that of average students, and both groups performed better than did low ability students. Performance on text based questions was higher than that on knowledge based questions. Both groups of trained students were generally superior to control group students in their response quality, and students whose teachers had received more extensive training were better able to identify the information source required by a given question, although they did not differ in their consistency or response quality. (Author/FL)

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Technical Report No. 284

INCREASING STUDENTS' SENSITIVITY TO SOURCES OF INFORMATION: AN INSTRUCTIONAL STUDY IN QUESTION-ANSWER RELATIONSHIPS

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Abstract

This study evaluated a program for instructing fourth grade students in the relationship between questions designed to test their comprehension of a text and the location of possible information for answering these questions. Six teachers participated in two levels of training: a traditional half-day teacher workshop and a more extensive training program that included provision of specific materials and weekly monitoring by researchers with feedback. Three dependent measures were created: (1) a student's ability to identify a question by the relationship between the question and the location of answer information, (2) consistency between question answer relationship identification and the apparent source of answer information, and (3) accuracy and completeness of the answer. Significant effects for ability and question types were in predicted directions. Performance of high ability students was superior to average and both were superior to low; performance on text based questions was higher than that on knowledge based questions. Both groups of trained students were generally superior to control groups in their quality of responses. In addition, students whose teachers had received more extensive training were better able to identify the information source required by a given question, though they did not differ in their consistency or response quality.

Increasing Students' Sensitivity to Sources of Information: An Instructional Study in Question Answer Relationships

Two of the most important considerations of instructional researchers should be: (a) theoretical justification for the research, and (b) implementation of the research findings into traditional classroom curricula. Unfortunately, many of the instructional practices observed in schools today are not supported by research. For example, Durkin (1979-79) has observed that teachers do not regularly instruct students in the development of comprehension skills, an area researchers believe to be critical to skilled reading. The complaint of researchers that practitioners are unresponsive to research findings is countered by a complaint of practitioners that instructional practices which researchers frequently propose have little or no utility for the classroom. The purpose of this paper is to describe an instructional study that attempts to be responsive both to theoretical concepts and to the exigencies of classroom practice.

Traditionally research in the analysis of questioning has fallen into three categories: (a) the categorization of questions into taxonomies, (b) the study of the kinds of questions frequently used in the classroom, and (c) the examination of the educational value of the question as a tool to enhance prose comprehension. This research suggests that a variety of question types exist, each type with an implied set of processing demands and strategies (Barrett, 1976; Pearson & Johnson, 1978). Additionally, question-answering during and following the reading of prose generally requires more responses to text-based, literal questions than to knowledge-

based, inferential questions (Guszak, 1967; Hare & Pulliam, 1979). Also, questions appear to enhance certain types of learning from text (Anderson & Biddle, 1975; Rickards, 1979). If a number of question types exist, each requiring a different question-answering strategy, and if questions enhance learning from text, then it seems reasonable to investigate the possibility that direct instruction in strategies for answering different types of questions might facilitate comprehension (especially as measured by students' ability to answer comprehension questions).

While ultimately, the ability to answer a question will depend upon the availability of the information, a fundamental aspect of the process is the awareness of appropriate sources of information for finding these answers. Teaching students to recognize the functional relationship between a question and the answer information locations became easier with the introduction of a taxonomy of questions by Pearson and Johnson (1978) which classified questions according to their relationship to two sources of information: the text or the readers' knowledge base. Their three category taxonomy includes text explicit (TE), text implicit (TI), and script implicit (SI) question answer relationships (QAR). A TE QAR reflects a question with an answer stated explicitly in the text; a TI QAR reflects a question with all information to answer it available in the text, but requiring the reader to integrate across sentences or paragraphs; a SI QAR reflects a question with an answer that must be supplied from the readers' background knowledge.

To determine if the apparent sensitivity to information sources differentiated between successful and unsuccessful readers, Raphael,

Winograd, and Pearson (1980) examined the performance of fourth, sixth, and eighth grade students in responding to questions from the three QAR categories. They found that high ability students were more sensitive to appropriate information sources. That is, they provided text based information for TE and TI questions, while providing knowledge based information for SI questions. Less skilled readers, in contrast, tended to be somewhat arbitrary in answering these questions from appropriate information sources and consequently often were incorrect.

A program designed to train students to recognize these three QARs was created by Raphael (1981) and successfully implemented with groups of fourth, sixth, and eighth grade students. The program was conducted over a period of four days. Using principles of modeling and fading, the researcher explained the three QARs, led the students through examples with rationales, gradually assigning increasing amounts of independent work with feedback on group and individual bases. As a result of participating in the program, students' performances were generally enhanced relative to a control group's performance.

These two studies indicated that sensitivity to sources of information did differentiate between good and poor readers' performance on question answering tasks, and the performance of less skilled readers was particularly enhanced following instruction. The next issue and primary concern of this study was whether such training could be implemented in the naturalistic environment of the classroom. Three questions were considered in this study: (a) What level of inservice training is necessary for teachers to successfully implement the QAR program? (b) What level of training is necessary for fourth grade students to demonstrate increased

proficiency in answering comprehension questions? (c) Will sensitivity to QARs transfer to classroom question answering activities? We predicted that inservice training with supporting materials and weekly feedback/monitoring sessions would be superior to inservice alone, and that training would enhance student performance in three areas: (a) sensitivity to the demands of the questions, (b) quality of their answers to the questions, and (c) consistency between their identification of the task demands of the question and the source of information for their actual answer.

Method

Subjects

Participating in the study were ten fourth grade teachers and 180 of their students from a semi-rural western community. Six of the teachers instructed students in the treatment groups, while four of the teachers instructed students in the control groups. The participating students were selected within schools from a population of 280 in three comparable elementary schools. Treatment groups were in two school sites while control groups were in the third. All schools were open in structure and used a team teaching approach. To maximize similarity among groups, several steps were taken. First, students who had been absent during any training or testing session were eliminated from the subject pool. Second, remaining students were blocked by ability using five measures: standardized reading and vocabulary scores from the ITBS achievement test, a decoding rate and error rate from a word identification list test, and teacher judgment. Fifteen students from each of three ability levels were

randomly selected for each of two treatment groups (for a total of 30 trained students each of high, average, and low ability levels), and the same was done for each of two control groups.

To further insure that randomization had resulted in equivalent groups, an analysis of variance was performed on the reading comprehension scores, revealing a significant difference, with students in the control group at a higher level than those in the training groups, $F(2,125) = 4.63$, $p < .05$. Analyses of covariance were used when comparisons across groups were performed, with the ITBS reading comprehension score as the covariate.

Materials

Training materials. Three student booklets, based upon the Pearson and Johnson (1978) taxonomy of question answer relationships, were created for use over three class periods during the first "intensive training" week of instruction. The first was designed to introduce the concept of QARs to the students using both text and visual aids. A series of brief (two to five sentence) passages were used, each followed by one question from each of the three QAR categories. Based on the notion of scaffolding, or moving from most to least support, the tasks began with the trainer and the booklet providing text, question, answer, QAR label, and the reason why the label was appropriate. Next, text, question, answer, and label were provided with the students providing the explanation and receiving immediate feeback on the accuracy and completeness of their explanations in their groups. Third, text, question, and answer was provided, with students supplying labeling and justification. Finally, students were provided with text and question and were asked to both answer the question

and indicate the QAR represented, using the following format, referred to as the QAR Task:

1. Why was brush popping a dangerous activity for the cowboy?

   RIGHT THERE _____

   THINK AND SEARCH _____

   ON MY OWN _____

Students answered the question on the line next to the QAR they felt the question and answer represented. The materials in the first booklet reflect this progression. In the second and third booklets, students practiced applying their QAR knowledge on progressively longer expository text, gradually building from 75 word to 400 word passages.

A second set of materials consisted of eight passages, each approximately 250 words in length and at a late third grade reading level, with six corresponding questions, two from each QAR category. These were the maintenance passages used weekly following the intensive training week.

Test materials. Four passages of 600-800 words in length were developed on topics rated in pilot studies as being familiar to fourth grade students (e.g., dogs, bicycles). The passages were created with minor revisions to naturally occurring passage from trade books and basal readers. Each passage was accompanied by eighteen related comprehension questions, six each from the TE, TI, and SI categories.

Teacher questionnaire. An informal teacher questionnaire was developed to assess the teachers' attitudes towards the overall program. The questions were divided into four areas: the extent to which their inservice training had been reasonable and adequate, the extent to which

the instructional program for the students had been reasonable and adequate, the effect the instruction was perceived to have had in transfer to content area subjects, and the extent to which the teachers would implement the program again when it was no longer related to participation in a research study.

Procedure

There were four procedures followed, one for each of the treatment/control groups. Each procedure will be described separately by group.

Training Group 1: Inservice with materials provided. Three teachers and their corresponding students comprised this group. First, these teachers received a half day inservice which involved instructing them in the three QARs, demonstrating the materials which would be used to instruct the students, and modeling how the instruction should proceed. Second, following administration to their students of one pretest passage, the teachers were observed and provided with daily feedback during the intensive training week during which time they used the three training booklets to instruct their respective students in QARs. At the end of this week students were tested on two of the passages. They were instructed to read each passage and answer the eighteen questions that followed, using the QAR task which required that they both identify the QAR and write the answer to the question on the line following the QAR selected. Third, teachers were observed weekly for eight weeks as they used the maintenance passages with their students who practiced identifying the QARs as they answered the questions. Again, the teachers were provided with feedback

following each lesson regarding the clarity and accuracy of their explanations to the students. Finally, in the week following the eighth maintenance passage lesson, students were tested under a transfer and a maintenance condition. In the transfer condition, passages and questions about dinosaurs--made to look like the science materials they typically used--were delivered when students were not in school. The materials made no mention of QARs, nor were the questions followed by the QAR task. Teachers administered the materials stating that they were beginning a unit on dinosaurs and they were to read the passage to themselves and answer the questions. In the maintenance condition a passage about bicycles with corresponding questions followed by the QAR task was administered by the researchers with directions to complete the work in the way they have been practicing during their QAR lessons.

Training Group 2: Training, no materials provided. This group of three teachers was designed to duplicate those circumstances under which teachers typically receive information about programs of use in their classrooms. The researchers met with them for a half-day period, during which time they taught them criteria for identifying the three QARs, as well as how to construct questions and answers from the texts they were using in their classrooms during reading, social studies, and science. A rationale for using the materials was described, then lessons that paralleled those in Training Group 1's materials were modeled for the teachers. Explicit instruction to the teachers described the importance of beginning with easier brief passages, gradually introducing the QAR task, and providing feedback to their students. The teachers were asked to keep a weekly journal of how they taught QARs in their respective classrooms,

that the researcher would be out on a weekly basis to collect the journals and answer their questions. While this would not be typical of most inservice followups, it was felt that it was the minimal way in which their lessons could be monitored to assure that they were, in fact, teaching about QARs to their students. These students were pretested on the same passage as Training Group 1, as well as a second passage (used by Training Group 1 after a week of intensive training). The pretest passage provided data to insure that the two groups initially did not vary significantly on their ability to answer questions, while the second passage allowed them to serve as a control group to the first training group.

Control Group 1: Practice. While it can be argued that children need no practice in answering questions, it was felt that a significantly higher performance by the trained students could be attributed to their systematic exposure to questions from each of the three QAR categories, rather than the traditional diet of predominantly literal questions. Thus, this group received all passages and questions of the training group 1 students, but received no training. The teachers in this group were led to believe that practice using the materials may improve students' ability to answer inference questions. These students then participated in the testing period which occurred at the end of the extensive training in the treatment groups. They were given both the transfer and the maintenance passages, but neither had reference to QARs. Both were merely passages followed by questions to which they wrote their answers.

Control Group 2: No treatment. This group of students was not expected to perform in any significantly different manner than those in

Control Group 1. They participated in the same testing period which occurred at the end of the extensive training in the treatment groups, received the two passages--maintenance and transfer--in the same form as the other control group, and were not exposed in any way to QARs or to practice on the QAR materials.

Results

Results will be presented and discussed in terms of the research questions raised in this study. After describing the three dependent measures, we will consider, in turn, the question of level of teacher inservice training, the optimal level of student instruction, and transfer effects. Three dependent measures were created based upon the students' ability to identify questions by QAR category and/or by the quality of their responses. The measures were easily derived from the QAR task format (cf. p. 7).

Hits. This dependent measure assessed the students' sensitivity to the task demands of a question. For each TE question identified as being a Right There QAR, students received a point, as they did for TI questions identified as Think & Search, and SI questions as On My Own. Thus, a total of 6 correct in each category was possible for each pasage.

Matches. To assess the students' internal consistency in QAR identification and actual location of the information they provided for an answer, a matrix was created with credit given to students who identified a QAR as TE or TI and gave text-based answer information (correct or incorrect) or who identified a QAR as SI and gave an answer (correct or incorrect) that required information not found in the text. Matches were

assigned independent of hit rating or answer quality. Again, a maximum of six correct per QAR category was possible.

Response quality. The students' quality of responses was assessed on the basis of both the accuracy and completeness of the answer. Extensive piloting of materials determined standards for the type and amount of information necessary for a complete and accurate answer. Students' answers in this study were compared against these standard answers.

As had been predicted, preliminary analysis on their correct responses to questions on two test passages revealed no significant differences between the two control groups, $F(1,68) = .659$, $p > .05$, and $F(1,68) = 1.33$, $p > .05$, on the two respective passages. Therefore, all additional analysis that were performed used a subset randomly chosen from the two control groups such that the number of subjects per cell was equal in each of the two training and one combined control groups.

Level of inservice training. The difference in the amount or level of inservice instruction and guidance was assessed on the basis of both students' performance levels from training groups 1 and 2 and from teacher questionnaires. Student performance levels will be discussed first.

Students' performance on response quality was assessed on the two passages which children responded to at the nine week testing point. Recall that the maintenance passage had questions followed by the QAR task, while the transfer passage had questions but no cuing to QARs. Thus, the maintenance passage also provided data on students hits and matches. Also recall that the transfer passage was formatted in a manner similar to activities participated in by the students during their typical activities, not like the experimental materials used in the training program. Analyses

of covariance (with reading comprehension scores from the ITBS as the covariate) revealed no significant differences between the two training groups' response quality on either passage, nor were there significant differences between the two training groups on any other variable or interactions on the transfer passage. The only main effects revealed were for question type, $F(2,250) = 71.95$, $p < .01$, and ability, $F(2,124) = 5.24$, $p < .01$ on the maintenance passage. These effects were further involved in a significant ability by question type interaction, $F(4,250) = 5.31$, $p < .01$. This interaction indicated that while TE and TI differentiated between ability groups as predicted, all students performed at the same level on SI questions (see Figure 1). On this particular passage, SI questions appeared to be inordinately easy, hence the unexpected result of higher performance on script than text questions, contrary to what typically occurs (e.g., Hansen, 1981; Raphael & Pearson, 1982). This result should probably be interpreted as a passage specific effect.

Insert Figure 1 about here.

In examining students' sensitivity to demands of particular questions, revealed by their ability to identify questions by QAR category (hits), significant differences were found for treatment, $F(1,82) = 9.34$, $p < .01$, with training group 1 ($M = 3.70$) performing at a higher level than did training group 2 ($M = 3.05$); and for question type, $F(2,166) = 12.66$, $p < .01$. Students were most adept at identifying SI QARs ($M = 3.99$), then TE ($M = 3.17$), with the least success on TI ($M = 2.96$). The treatment effect

was further explained in the significant treatment x ability interaction, $F(2,82) = 4.04$, $p < .05$. The treatment effect appears to be due solely to the differences in performance of the high and average ability students (see Figure 2). While all students performed at a better than chance, for students of average and high ability, performance on "hits" or QAR identification was apparently enhanced by the more systematic program.

Insert Figure 2 about here.

In examining students' sensitivity to their own behavior, the "match" between the selected QAR and the probable location of their answer information (e.g., text or knowledge base), analysis of covariance revealed no significant differences between training groups. Main effects for both ability, $F(2,82) = 4.14$, $p < .05$, and question type, $F(2,166) = 18.28$, $p < .01$, were in the expected directions. Performance was higher as a function of ability levels, M high = 4.93, M average = 4.20, M low = 4.12. Performance was higher on text (M TE = 4.69, M TI = 4.71) than SI (M = 3.84) questions.

Teachers' responses to the questionnaire were based upon a five-point scale ranging from Strongly Disagree (1) to Strongly Agree (5). (Due to the small size of the group responding to the questionnaire, no formal analyses were performed.) Considering both groups' ratings, the scores ranged from 3.2 to 4.8 in response to questions relating to the utility, adequacy, and reasonableness of the program. When examined with groups separated, those in training group 1 strongly agreed that inservice training was adequate (5.00) and reasonable (5.00) in terms of time

demands, the program procedures for instructing the students were adequate (5.00) and reasonable (5.00). Also these teachers felt that the materials provided for student instruction were adequate (5.00). In contrast, while training 2 agreed on both the adequacy and reasonableness of the inservice (4.50) and student instructions (4.00), they were neutral (3.00) regarding the materials provided for instruction. In an open-ended question regarding improvements to make in the program, those in training group 2 again stated the need for more training materials for the students.

In summary, it is just as effective, in most cases, to provide a simple inservice. The provision of the materials, but not more teacher training, was viewed as helpful, and possibly was instrumental in enhancing students' recognition of QAR categories.

Optimal level of training for student performance. Students in training group 1 were tested at the end of one week of training and compared to students from training group 2 who had not yet begun their training and, thus, served as a control group. There was no significant difference in treatment effect on response quality. However, this finding must be qualified due to the fact that those in training 1 were asked to use the QAR task when answering their questions. That is, they circled the QAR, then wrote their answers on the blank following that QAR. The students serving as a control group merely wrote their answers to the questions. Thus, students in each group may have been performing two different tasks. There were, however, main effects on response quality for ability, $F(2,82) = 3.87$, $p < .05$, and question type, $F(2,166) = 60.14$, $p < .01$. The performance levels decreased with ability level, M high = 4.65, M

average = 4.12, M low = 3.69; performance was higher for both text QARs (M TE = 4.71, M TI = 4.56) than for the knowledge based QAR (M SI = 3.18).

The second testing point was at the end of the ninth week of participation in the study. Recall that students read two passages, one maintenance and one transfer, and answered questions. Results of the transfer passage, discussed in detail below, indicate that after one week of intensive training and eight weeks of maintenance or practice, students in both training groups had a higher level of response quality than those in the control group. All students, on this passage, performed the same task of reading and answering questions without the QAR task. Results of the maintenance passage, reported in discussing level of teacher inservice training, showed no effect of training on response quality. However, on this passage, as was the case after the intensive week of training, students in both training groups answered questions and identified QARs, while those in the control group merely answered the questions.

Evidence of transfer. The transfer effect was assessed on the passage that represented work typically done in classroom activities, with care being taken that it was similar to classroom tasks in both appearance and style, and that children did not see the materials being delivered. Students were not cued by the teacher to think of QARs when answering the questions, though some students asked if they were "allowed to use QARs." A noncommittal answer (e.g., you may if you wish, but you do not have to) was given to such queries. Analysis of covariance involving both training groups and the control group revealed significant main effects for treatment, $F(1,124) = 7.62$, $p < .01$, and ability, $F(2,124) = 3.88$, $p < .05$, with effects in predicted directions. However, both factors were involved

in a significant two-way interaction, $F(4,124) = 2.44$, $p < .05$ (see Figure 3). The effect can be attributed primarily to the greater differences between the training groups and the control group as ability levels decreased. In fact, training appeared to enhance performance such that average and low ability students' performance levels did not differ from that of high ability students.

Insert Figure 3 about here.

Discussion

Three questions were raised in this study. The first concerned the amount of inservice teacher training necessary for successfully implementing the program. Based upon students' performance levels, it appeared that inservice training alone is sufficient to encourage students' internal consistency in "matching" their QAR identification to the location of the answer information, and to enhance their response quality. For teaching students to identify QARs, however, the more extensive training and provision of materials appears to be necessary. In addition, the teachers themselves in training group 2 indicated a need for additional materials, though not more training. This would suggest that while inservice training is sufficient in most cases, the availability of materials and some feedback is a beneficial luxury.

The second issue concerned the amount of training necessary for student understanding and application of QAR knowledge. This issue remains unresolved due to the unexpected role of the QAR task itself. In designing

the experiment, it was expected that the greatest advantage to trained students would occur when they were cued to recall the information sources about which they had been taught. Therefore, in providing settings in which students in the trained groups answered questions using the QAR task and control group students merely answered the questions, it was expected that differences would be maximized. However, it appears that precisely the opposite effect occurred. When students did not use the QAR task (on the transfer passage), training was superior to control. When, in the Raphael and Pearson (1982) study, both groups used the QAR task, trained students were also superior in response quality to control students. When the trained students in this study did use the task and the control students did not, at the end of one week and on one passage at the end of nien weeks, there were no differences. Therefore, while the data indicates at a surface level a need for more extensive training (i.e., one intensive week and 8 weekly maintenance lessons)--particularly on the transfer test--the fact that trained students did not perform as well with the task as without calls such a conclusion into question. It may be that at the fourth grade level, the extra attention required by the QAR task detracted from attention to accessing answer information or monitoring answer correctness, or that students were less motivated for unknown reasons when the task was present. The reasons can only be determined by further research.

The third issue concerned the transfer of QAR training to a situation which differed from the training task, yet reflected typical school question answering activities. The mock science lesson reflected the types

of reading/question answering activities in which children had participated throughout the year, and the materials were constructed to resemble class materials rather than the printed experimental materials. The higher performance of students in both training groups in contrast to the control groups suggests that students benefitted from QAR training even, or especially, when such knowledge was not cued. This is an encouraging finding as often training programs do not result in transfer to uncued situations. This was clearly a case of "near transfer" as the task was generally similar and proximal to the training program, but it was encouraging nonetheless. Further, as other studies (e.g., Hansen & Pearson, 1982) suggest, training was most facilitative for students of average and lower ability levels. One would assume that high ability students already possess such knowledge, at least implicitly, and would not particularly benefit from such training.

Recently researchers such as Paris (1978) have drawn attention to the importance of explicitly relating means and goals in instructional settings. Psychologists in the Soviet tradition (e.g., Vygotsky, 1978; Wertsch, 1979) have stressed the notion of "scaffolding" and modeling in providing instruction in a number of settings. This study provides further support of such concepts as they relate to providing children with some of the fundamental knowledge underlying the task of answering a comprehension question: recognizing the availability of information sources. Finally, researchers (e.g., Smirnov & Zinchenko, 1969) have suggested that students may first need to learn means (e.g., identifying sources of information) as ends in and of themselves before they can be successfully applied in the service of a higher order goal (answering comprehension questions).

Students in this study first learned to identify a QAR as an end in and of itself. When they were successful in this task, they moved on to applying it in answering questions. Apparently, this is one means by which instruction can be successfully structured.

Future research in QARs needs to examine the role of the QAR task, possibly as a within subjects variable. Also, although performance did improve, one infers as a result of training, current methodology did not permit the assessment of process measures; that is, in what way did training affect the readers' interactions with the text. Future research, possibly using the capabilities of microcomputers to measure on-line changes in performance, could provide valuable information about changes in the reading and question answering processes after training in question answer relationships.

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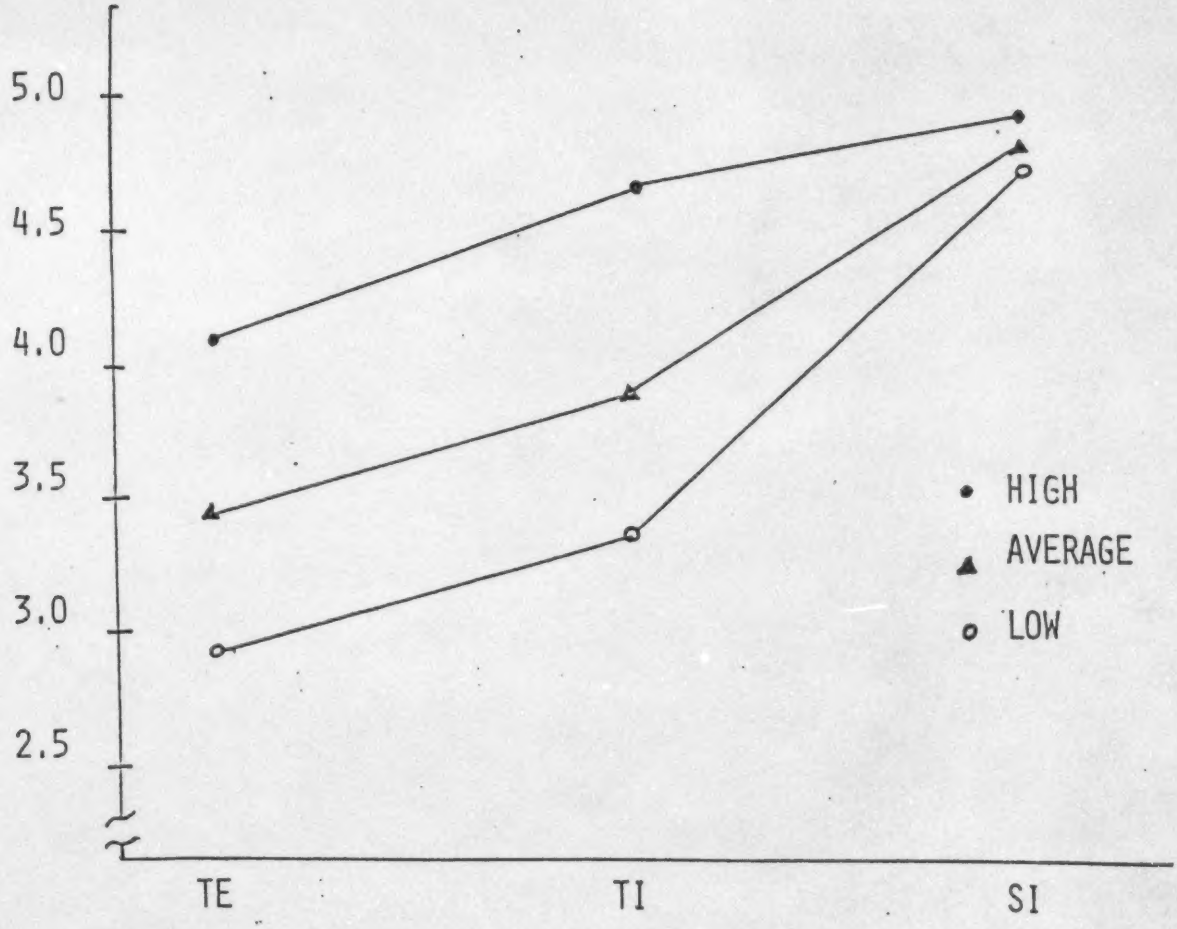
Figure Captions

Figure 1. Graph of the ability x question type interaction, response quality, maintenance passage.

Figure 2. Graph of the ability x treatment interaction, hits, maintenance passage.

Figure 3. Graph of the ability x treatment interaction, response quality, transfer passage.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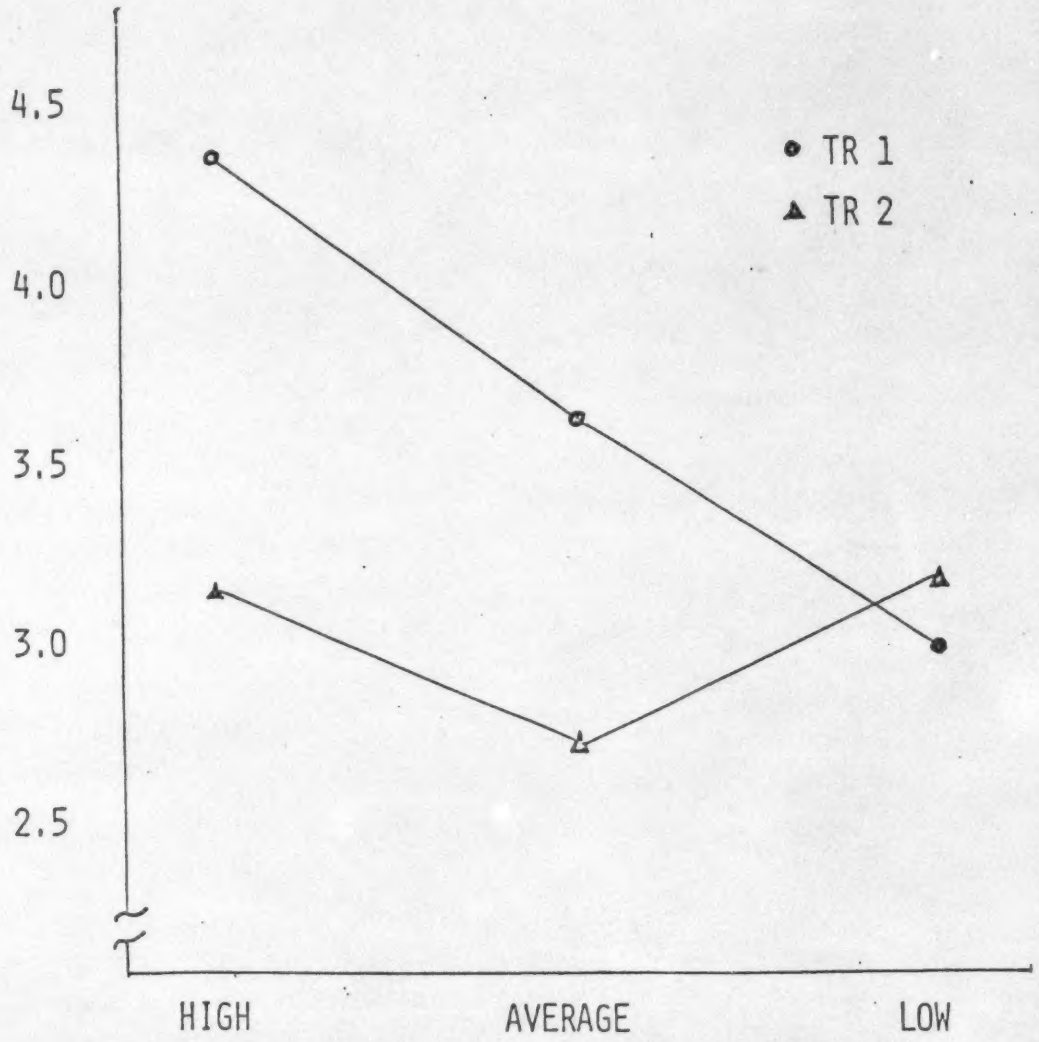
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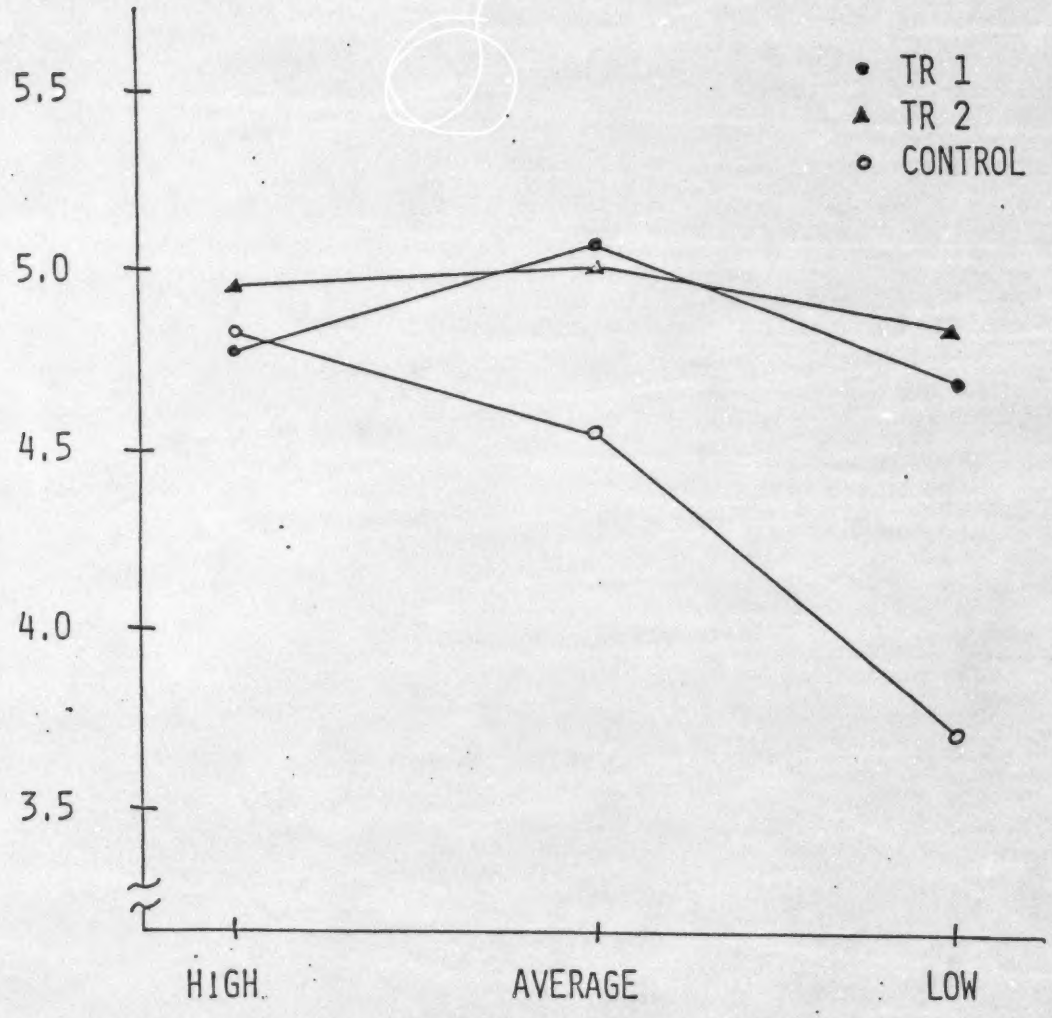
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